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Root Exudation of Herbicides by Woody Plants: Allelopathic Implications

MANY endogenous substances are exuded by plant roots. The release from one plant of substances which have an inhibitory influence on another plant (allelopathy) has been recognized as an important factor in plant/plant interactions in agricultural practices² and also seems to have considerable ecological importance in vegetational composition³. Root exudation of exogenous compounds has also been shown to affect neighbouring plants⁴⁻⁶. In 1963, the known exudation of regulating substances from roots was limited to two families of compounds, methoxyphenylacetic acids and chlorinated benzoic acids⁵. Since then the exudation of 2,4-dichlorophenoxy-acetic acid^{7,8} and picloram^{9,10}, both exceptions to the above classification, has been shown.

In recent investigations we have demonstrated that both 4-amino-3,5,6-trichloropicolinic acid (picloram) and 2,4,5-trichlorophenoxyacetic acid are exuded from the roots of ash and maple in significant quantities when applied to the foliage. ¹⁴C-picloram and ¹⁴C-2,4,5-trichlorophenoxyacetic acid, both labelled at the carboxyl position, were applied in sublethal dosages to the foliage of red maple (*Acer rubrum* L.) and green ash (*Fraxinus pennsylvanica* Marsh.) seedlings grown in nutrient solution in controlled environmental conditions. Exudation of the herbicides from the roots was monitored by removing samples from the root-bathing solution periodically and counting for ¹⁴C in liquid scintillation. The total ¹⁴C loss from the roots after 22 days and the loss as a percentage of the total quantity of ¹⁴C-labelled herbicide which actually entered the plant from the leaf surfaces are shown in Table 1. It can be seen that significant quantities of herbicide were lost from the roots in all treatments. Results from paper co-chromatography of the nutrient solutions suggested that the ¹⁴C activity was associated

Table 1. TOTAL ¹⁴C ACTIVITY RECOVERED IN NUTRIENT SOLUTION 22 DAYS AFTER INTRODUCTION OF ¹⁴C-LABELLED HERBICIDES TO FOLIAGE

Herbicide	Species	c.p.m.*	As per centage†
Picloram	Ash	1,901	1.6
	Maple	7,003	6.2
2,4,5-Trichlorophenoxyacetic acid	Ash	2,690	3.8
	Maple	4,018	8.4

* Values represent the mean of six replications.

† Root loss as percentage of ¹⁴C-labelled herbicide actually entering plant

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with the unaltered ¹⁴C-labelled herbicide molecules for both 2,4,5-trichlorophenoxyacetic acid and picloram.

Because of the reported persistence of picloram in soils^{11,12}, the exudation of this growth regulator may be of greater ecological consequence than the exudation of previously reported compounds. In order to understand more fully the physiological and ecological effects of using growth regulating substances in woody plant control, consideration must be given to the possibility that significant amounts of herbicides may be exuded from roots into the rhizosphere.

These investigations are being extended and will be published in detail later.

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